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Necessity of the Adaptive Comfort Standard for the Middle East in the Times of Rising Energy Use

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Middle East (ME) supplies more than 47% oil exported in the world (IEA 2013) and has highest energy self-sufficiency in the world. It includes 12 countries and has a population of 205 million in 2010, which increased by about 61.4% from 1990 (IEA 2010). Its energy demand has increased astronomically at the rate of 7% per year, since 1971–2013, faster than in any other region in the world. Buildings majorly contribute to this. Building energy (residential, commercial and public use buildings) use in the ME has increased by about 46% in the period 2003–13 (IEA 2010).

Ironically ME houses only about 3% of the world's population, but it contributes to 13% of global CO_2 emissions. Understandable, its per capita CO_2 emission is one of the highest in the world at 7.53 tons of CO_2/capita, 68% higher than the world average. Therefore improving the energy efficiency remains a key challenge for the region. International Energy Agency (IEA) identifies the development and enforcement of building energy codes coupled with energy consumption data generation as the top energy efficiency policy recommendations for this region (IEA 2014).

Qatar's per capita energy consumption is one of the highest, consuming 30.184 TWh as of 2012 (IEA 2012) Buildings contribute majorly (80%) to this, with air-conditioning taking a lion's share. With the absence of custom-made energy/thermal comfort standards, the buildings tend to follow western standards meant for colder climates verbatim. Cheap energy availability and tariffs exacerbate this practice (Fattouha and El-Katiri 2013). Often times, energy analysis and conservation come as postmortem ideas than at the design stage. And the energy subsidies often prove to be unrealistic and unsustainable in the long run.

Qatar has little research on occupant thermal comfort and preferences in buildings. Energy efficient building design necessitates this. As part of large energy conservation web tool design for Qatar, we conduct year long occupant

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surveys in office buildings to understand the nature of the building stock and occupant thermal comfort and preferences along side their thermal adaptations.

Saudi Arabia stands sixth in world's oil consumption and already uses a quarter of its own production. Building energy consumption in Saudi Arabia went up astronomically by 60.8% in five years from 2007 to 2012. Energy analysts argue that Saudi Arabia could turn into a net oil importer by 2030 if current demand, growth patterns continue. Air conditioning majorly contributes to this. Recent research posits that the building envelope codes have a limited role to play in reducing energy consumption (Radhi 2009).

Saudi building code specifies two design temperatures of 20 °C and 25.5 °C for winter and summer, for all climate and building types, much similar to the building codes of other countries like UAE (SBCNC 2007). Relying on Fanger's heat balance model (Fanger 1972), the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard -55 (1992) formed the basis for this. This Standard is long since superseded (ASHRAE 1992).

Environments designed based on this model produce thermal monotony (uniform indoor temperatures yearlong), with the indoor environments delinked from the outdoors. It ignores the local climate, clothing, culture or comfort practices of Saudis. Researchers all across the globe criticized such rigid and unsustainable indoor temperatures.

The Adaptive model of Thermal Comfort on the other hand hinges on the field studies in real life buildings. People in their everyday environments are studied in order to develop the temperature standards that truly represent local climate, people, their comfort practices and adaptation mechanisms. Saudi Arabia is yet to develop its Adaptive Thermal Comfort Standards (ACS) (Nicol and Humphreys 2009) (CIBSE, (The Chartered Institution of Building Services Engineers) 2006, Indraganti, et al. 2014) (ASHRAE 2010) (ASHRAE 2010).

The potential of occupant's adaptation and the ACS is in producing sustainable indoor environments is long since been recognized. Therefore, this presentation highlights the necessity of the Adaptive Comfort Standards for the ME in the context of its growing energy concerns. It relies on the results of the first field studies we have conducted in Japan and India, KSA and Qatar and also draws heavily from the current research around the world.

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